New Pages of the
Technical Specifications

3.6 CONTAINMENT SYSTEMS

3.6.1.9 Feedwater Leakage Control System (FWLCS)

LCO 3.6.1.9 Two FWLCS subsystems shall be OPERABLE.

APPLICABILITY: MODES 1, 2, and 3.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One FWLCS subsystem inoperable.	A.1 Restore FWLCS subsystem to OPERABLE status.	30 days
B. Two FWLCS subsystems inoperable.	B.1 Restore one FWLCS subsystem to OPERABLE status.	7 days
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 4.	12 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.1.9.1 Perform a system functional test of each FWLCS subsystem.	18 months

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SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.6.1.3.11	Verify each instrumentation line excess flow check primary containment isolation valve actuates within the required range.	18 months

INSERT

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SURVEILLANCE		FREQUENCY
SR 3.6.1.3.12	------------------NOTE-------------------- Only required to be met in MODES 1, 2, and 3. --- Verify that the combined leakage rate for both primary containment feedwater penetrations is ≤ 3 gpm when pressurized to ≥ 1.1 P_a.	18 months

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.2.3.1	Verify each RHR suppression pool cooling subsystem manual, power operated, and automatic valve in the flow path that is not locked, sealed, or otherwise secured in position is in the correct position or can be aligned to the correct position.	31 days
SR 3.6.2.3.2	Verify each RHR pump develops a flow rate ≥ 5050 gpm through the associated heat exchanger to the suppression pool. 4550	In accordance with the Inservice Testing Program

Technical Specification Bases Changes

B 3.6 CONTAINMENT SYSTEMS

B 3.6.1.9 Feedwater Leakage Control System (FWLCS)

BASES

BACKGROUND

Following a DBA LOCA, the FWLCS supplements the isolation function of primary containment isolation valves (PCIVs) in the feedwater lines which also penetrate the secondary containment. These penetrations are sealed by water from the FWLCS to prevent fission products (post-LOCA containment atmosphere) from leaking past the isolation valves and bypassing the secondary containment after a Design Basis Accident (DBA) loss of coolant accident (LOCA).

The FWLCS consists of two independent, manually initiated subsystems. Each subsystem uses its connected train of the residual heat removal (RHR) system and a header to provide sealing water for pressurizing the feedwater piping either between the inboard and outboard feedwater line isolation check valves or between the outboard containment isolation check valve and the outboard motor-operated gate valve.

APPLICABLE SAFETY ANALYSES

The analyses described in Reference 1 provide the evaluation of offsite dose consequences during accident conditions. The analyses take credit for manually initiating FWLCS within 20 minutes following the initiation of a DBA LOCA (assuming termination of feedwater flow through the feedwater lines), after which secondary containment bypass leakage through the feedwater lines is assumed to continue until the associated piping is filled, which occurs within one hour after initiation of the accident.

The FWLCS satisfies Criterion 3 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO

Two FWLCS subsystems must be OPERABLE so that in the event of an accident, at least one subsystem is OPERABLE assuming a worst-case single active failure. A FWLCS subsystem is OPERABLE when all necessary components are available to pressurize each feedwater piping section with sufficient water pressure to preclude containment atmosphere leakage (following the time period required to fill and pressurize the feedwater piping sections) when the containment atmosphere is at the maximum peak containment pressure, P_a.

APPLICABILITY

In MODES 1, 2, and 3, a DBA could cause a release of radioactive material to primary containment. In MODES 4 and 5, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, the FWLCS is not required to be OPERABLE in MODES 4 and 5 to prevent leakage of radioactive material from primary containment.

ACTIONS

A.1

With one FWLCS subsystem inoperable, the inoperable subsystem must be restored to OPERABLE status within 30 days. In this Condition, the remaining OPERABLE FWLCS subsystem is adequate to perform the required leakage control function. The 30-day Completion Time is based on the low probability of the occurrence of a DBA LOCA, the amount of time available after the event for operator action to prevent exceeding this limit, the low probability of failure of the OPERABLE FWLCS subsystem, and the availability of the PCIVs.

B.1

With two FWLCS subsystems inoperable, at least one subsystem must be restored to OPERABLE status within 7 days. The 7 day Completion Time is based on the low probability of the occurrence of a DBA LOCA, the availability of operator action, and the availability of the PCIVs.

(continued)

BASES

ACTIONS (continued)

C.1 and C.2

If the inoperable FWLCS subsystem cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 12 hours and to MODE 4 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.1.9.1

A system functional test of each FWLCS subsystem is performed to ensure that each FWLCS subsystem will operate through its operating sequence. This includes verifying the automatic positioning of valves and operation of each interlock, and that the necessary check valves open. Adequacy of the associated RHR pumps to deliver FWLCS flow rates required to meet the assumptions made in the supporting analyses was demonstrated during acceptance testing of the system after installation. Periodic verification of the capabilities of the RHR pumps is performed under SR 3.5.1.4.

The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power.

REFERENCES

1. USAR, Section 15.6.5.

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BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.1.3.11 (continued)

pressure or flow range. This SR provides assurance that the instrumentation line EFCVs will perform so that predicted radiological consequences will not be exceeded during the postulated instrument line break events (Ref. 7). The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power.

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REFERENCES

1. USAR, Chapter 15.6.5.
2. USAR, Section 15.6.4.
3. USAR, Section 15.7.4.
4. USAR, Section 6.2.
5. USAR, Table 6.2-47.
6. 10 CFR 50, Appendix J, Option B.
7. Regulatory Guide 1.11.

INSERT page B 3.6-28

SR 3.6.1.3.12

This SR ensures that the combined leakage rate of the primary containment feedwater penetrations is less than the specified leakage rate. The leakage rate is based on water as the test medium since these penetrations are designed to be sealed by the FWLCS. Meeting the 3 gpm limit has been shown by testing and analysis to bound the condition following a DBA LOCA where for a limited time both air and water could be postulated to leak through this pathway. The leakage rate of each primary containment feedwater penetration is assumed to be the maximum pathway leakage, i.e., the leakage through the worst of the two isolation valves [either 1B21-F032A(B) or 1B21-F065A(B)] in each penetration. This provides assurance that the assumptions in the radiological evaluations of References 1 and 2 are met. Dose associated with leakage (both air and water) through the primary containment feedwater penetrations is considered to be in addition to the dose associated with all other secondary containment bypass leakage paths.

The Frequency is consistent with other testing used to verify PCIV leakage.

A Note is added to this SR which states that the primary containment feedwater penetrations are only required to meet this leakage limit in Modes 1, 2, and 3. In other conditions, the Reactor Coolant System is not pressurized and specific primary containment leakage limits are not required.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.2.3.2

Verifying each RHR pump develops a flow rate ≥ 5050 4550 gpm, with flow through the associated heat exchanger to the suppression pool, ensures that pump performance has not degraded during the cycle. Flow is a normal test of centrifugal pump performance required by ASME Section XI (Ref. 2). This test confirms one point on the pump design curve, and the results are indicative of overall performance. Such inservice inspections confirm component OPERABILITY, trend performance, and detect incipient failures by indicating abnormal performance. The Frequency of this SR is in accordance with the Inservice Testing Program.

REFERENCES

1. USAR, Section 6.2.
2. ASME, Boiler and Pressure Vessel Code, Section XI.
3. USAR, Section 5.4.7.

Technical Bases for the FWLCS Mode of RHR

Overview

As mentioned in Attachment 2, primary containment isolation valves having a qualified seal system are not required to be included in the LLRT program. Rather, a periodic functional leakage test is performed for the penetration to verify acceptable leakage performance. The design basis for the FWLCS mode of RHR is to provide a water seal for 1B21-F032A & B and for 1B21-F065A & B no later than one hour following a design basis LOCA (recirculation suction line break). Other LOCA events, such as a feedwater line break, were evaluated to establish that no other LOCA event could create a more bounding radiological release condition than the DBA LOCA.

Two redundant trains of FWLCS will be added to accomplish this function. The "A" train of FWLCS supplies water to the feedwater piping on the reactor side of 1B21-F065A & B. The motor-operated valve supplying the sealing water for this train of FWLCS will only open if 1B21-F065A & B are closed and feedwater piping system pressure is less than the maximum operating pressure of the RHR system. The "B" train of FWLCS is similar to the "A" train except that it supplies water to the feedwater piping on the reactor side of the 1B21-F032A & B valves.

Design Basis

The FWLCS mode is designed in accordance with Seismic Category I and Quality Group classification requirements to comply with RG 1.26 and RG 1.29. The system meets the intent of RG 1.96, where applicable. In the absence of a specific Regulatory Guide for the FWLCS, the guidance contained in RG 1.96 was utilized. Accordingly, FWLCS design requirements or considerations include the following:

- The FLWCS mode is capable of performing its safety function, when necessary, considering effects resulting from a LOCA, including missiles that may result from equipment failures, dynamic effects associated with pipe whip and jet forces and normal operating and accident caused local environmental conditions consistent with the design basis event.

- The FWLCS mode is capable of performing its safety function following a LOCA and assumed single active failure.

- The FWLCS mode is designed such that the effects resulting from failure of a single active component of the leakage control system will not affect the integrity or operability of connected systems.

- The FWLCS mode is capable of performing its safety function following loss of all offsite power coincident with a postulated design-basis LOCA and breaks in both FW lines outside containment in non-seismic portions of the piping. Power for the two redundant trains of the FWLCS is supplied from independent safety-related divisional sources.

- The FWLCS mode is designed with sufficient capacity and capability to control leakage in the FW system for as long as postulated accident conditions require containment integrity to be maintained.

- The FWLCS mode is manually actuated and is designed to permit actuation within about 20 minutes after a postulated design-basis LOCA. Interlocks will prevent FWLCS injection until FW pressure has decayed to an acceptable level.

- Instrumentation and circuits necessary for the functioning of the FWLCS mode are designed in accordance with standards applicable to an engineered safety feature.

- The FWLCS controls include interlocks to prevent inadvertent operation of the FWLCS mode. In particular, interlocks are provided to prevent damage to the FWLCS subsystems or the existing RHR systems due to inadvertent opening of the FWLCS motor-operated isolation valves whenever the pressure in the connecting FW system exceeds FWLCS subsystem or RHR maximum operating pressure. All such controls and interlocks are activated from appropriately designed safety systems or circuits.

- The FWLCS mode has been designed to permit functional testing of the system during plant shutdowns.

- The FWLCS mode is designed so that any effects resulting from the use of the fluid sealing medium (RHR water), such as thermal stresses and pressures associated with the activated system, will not affect the structural integrity or operability of the FW lines or FW isolation valves.

- The FWLCS mode, including the source of the sealing fluid (suppression pool water via the RHR system), is designed in accordance with Seismic Category I and Quality Group B requirements. RG 1.96 does state, however, that any leakage control system piping that connects to Main Steam (FW in this modification) between inner and outer isolation valves should be designed in accordance with Seismic Category I and Quality Group A requirements supplemented by Appendix A of the Guide. This Appendix gives additional pipe stress and inspection requirements consistent with requirements for Group A piping between inboard and outboard isolation valves. Although the FWLCS "B" train connects to a section of the FW piping classified as Quality Group A, it has been classified as Quality Group B because the tap from FWLCS to this piping is 3/4 inch. Per Section 3.2.3.2.1 of the Clinton USAR, piping of this size (or smaller) may be classified as Quality Group "B" even though it connects to Quality Group A piping. The basis for this exception is that a break of this size will not prevent an orderly reactor shutdown and cooldown.

- Additionally, the FWLCS is not required to perform its safety-related fill and fill-maintenance function in the FW lines when a FW line break has occurred inside primary containment, since it has been demonstrated by analysis that the consequences of this postulated condition are bounded by those of the DBA LOCA.

Single Failure / Redundancy and Separation

The FWLCS mode is designed to perform its safety function considering a single failure of any component in the system. The FWLCS mode consists of two independent trains, one taking supply from the RHR "A" train and the other taking supply from the RHR "B" train. If one of these trains were unavailable, the other could perform the complete FWLCS safety function of creating a water seal on both trains of FW piping in the 40 minute time limit. The 40 minute time frame is based on dose data determined by calculation for a total back leakage of 3 gallons per minute.

The FWLCS "A" train, the RHR "A" pump, and the 1B21-F065A & B outboard isolation valves are powered from Division 1. The FWLCS "B" train, and the RHR "B" pump are powered from Division 2. This ensures that at least one train of FWLCS will be available should one divisional power source be lost.

Each train of FWLCS contains one motor-operated keep fill valve and two check valves (one check valve for each branch of FWLCS piping connecting to the FW lines). If a motor-operated valve or check valve in one train fails to open, the other FWLCS train could perform the FWLCS safety-related function. Each FWLCS line has a pressure switch which, if FWLCS pressure exceeds the maximum operating pressure of the RHR system, provides a permissive interlock that prevents the motor-operated valve from opening if closed and closes the motor-operated valve if open. This feature protects the RHR system from overpressurization in the event of a check valve being stuck open.

The two trains of FWLCS are physically separated until they enter the steam tunnel and connect to the FW piping. The FWLCS piping in the steam tunnel has been checked for missile, pipe whip and jet impingement effects due to a failure of adjacent high energy piping, and no single condition can result in failure of both the FWLCS trains. Additionally, an evaluation of the postulated breaks in the new FWLCS piping has found that it will not impact any existing safety-related components.

The FWLCS electrical design features meet the requirements for failure of a single active component, redundancy, and separation. The two redundant trains of FWLCS are divisionally separated into Divisions 1 and 2. The motor control centers (MCCs) are physically located in different rooms in the plant and the cables are run in divisionally separated cable trays/conduit. Electrical isolation from the non-1E plant computer is provided via optical isolators. The two MCCs are powered from busses 1A and 1B which are fed from the diesel generators in the event of a loss of offsite power. The equipment is seismically qualified to ensure it is operational in the event of a design basis seismic event.

Containment Isolation

The new motor-operated FWLCS valves (1E12-F496 and 1E12-F497) are the first power-operated valves outside primary containment for the FW primary containment penetrations, and therefore are classified as primary containment isolation valves in accordance with General Design Criteria 55 and 56. Since these valves support an engineered safety system, automatic isolation features are not required. The valves can, however, be closed by the operator from the main control room. This design is consistent with the design basis for containment isolation valves described in Section 6.2.4 of the USAR. The new FWLCS check valves 1E12-F495A and B and 1E12-F499A and B, as well as valves 1E12-F496 and 1E12-F497, perform a pressure isolation function between the reactor coolant system and the low pressure RHR system. Existing RHR relief valves will prevent overpressurization of RHR due to minor leakage through the check valves and the MOVs. As stated in the previous section, sufficient redundancy has been provided to prevent overpressurization of the RHR system.

Leak Detection Requirements

Since the new reactor coolant pressure boundary piping installed by this modification is installed in areas which already contain reactor coolant pressure boundary piping, existing leak detection features described in USAR section 5.2 and Tables 5.2-9a and 5.2-9b will detect reactor coolant leakage from these new lines. Therefore, the CPS evaluation against GDC 30 as stated in USAR section 3.1.2.4.1.1 is unaffected by this change.

System Performance

The FWLCS has been designed to satisfy the post-LOCA FW fill requirements using the RHR pump during the two low pressure coolant injection (LPCI) modes, the suppression pool cooling mode, and the containment spray mode of the RHR system. The minimum flow required for filling the feedwater lines in 40 minutes after FWLCS initiation (one hour after the DBA LOCA occurrence) is 66 gallons per minute for the RHR "A" train and 57 gallons per minute for the RHR "B" train. Both trains of the RHR system are capable of completely filling the horizontal portion of both FW penetrations between the outboard isolation valve (1B21-F065A & B for FWLCS train "A" and 1B21-F032A & B for FWLCS train "B") and the elbow at the FW vertical pipe risers to the reactor nozzles within 40 minutes of FWLCS initiation. The FWLCS mode will be operator initiated approximately 20 minutes after a LOCA event occurs, which is the same time frame for MSIV LCS initiation.

The system is designed to operate during modes A-1 (LPCI with as high as 53.7 psia reactor pressure and a 24 psi differential pressure between the reactor and the suppression pool), mode A-2 (LPCI with 14.7 psia reactor and suppression pool pressure), mode B-1 (suppression pool cooling), and mode B-2 (containment spray). Modes D-1 (initiation of shutdown cooling), D-2 (continuation of shutdown cooling), and E-1 (continuation of shutdown cooling and functional pump test after shutdown) all occur after initial FWLCS fill (one hour after LOCA) and flood at least one train of the feedwater system during operation. Provisions must be made for maintaining fill in any unflooded feedwater train from the RHR train operating in mode A-1, A-2, B-1, or B-2. Mode E-2 (continuation of shutdown cooling with return to the upper containment pool and functional pump test after shutdown) is not considered to be operating while FWLCS is required. Modes F (RHR system test during plant operation), G (minimum flow bypass mode - two suction sources), and S (system on standby duty), are normal plant operating modes which were not considered to provide FWLCS initial fill or supply.

Electrical / Instrumentation and Control Design

This modification includes adding motor-operated FWLCS valves 1E12-F497 (Division 1) and 1E12-F496 (Division 2). Valve operation will normally be controlled from the main control room where hand switches and corresponding indication lights will be utilized. The control board mimic will be modified for each switch and for the FW system to show the piping flow path.

For Division 1, interlocks/permissives are provided to ensure that valve 1E12-F497 will only open if valve 1B21-F065A and valve 1B21-F065B are closed and the pressure in the feedwater lines is low enough to prevent over-pressurization of the RHR line. The pressure permissive is provided by pressure switch 1E12-N664. The motor-operated valve (1E12-F497) will close when the control switch is manually turned to "close" and it will also close automatically upon loss of any of the previously described interlocks/permissives. Indication of valve closure is provided to the plant computer.

For Division 2, interlocks/permissives are provided to ensure that valve 1E12-F496 will only open if the pressure in the feedwater lines is low enough to prevent over-pressurization of the RHR line. The pressure permissive is provided by pressure switch 1E12-N663. The motor-operated valve (1E12-F496) will close when the control switch is manually turned to "close" and will close automatically upon loss of the previously described pressure permissive. Indication of valve closure is provided to the plant computer.

The FWLCS modification will not increase loading on the diesel generators. The MOVs are intermittent loads that would not be actuated until approximately 20 minutes following a LOCA. Also, based on pump characteristics at operational flow levels, the required flow from the RHR pumps (with FWLCS added) does not increase the maximum BHP requirements, so there is no increase in electrical power requirements for the pumps due to addition of the FWLCS mode. Therefore, the FWLCS modification will not increase the loading on the diesel generators.

Environmental Qualification Design

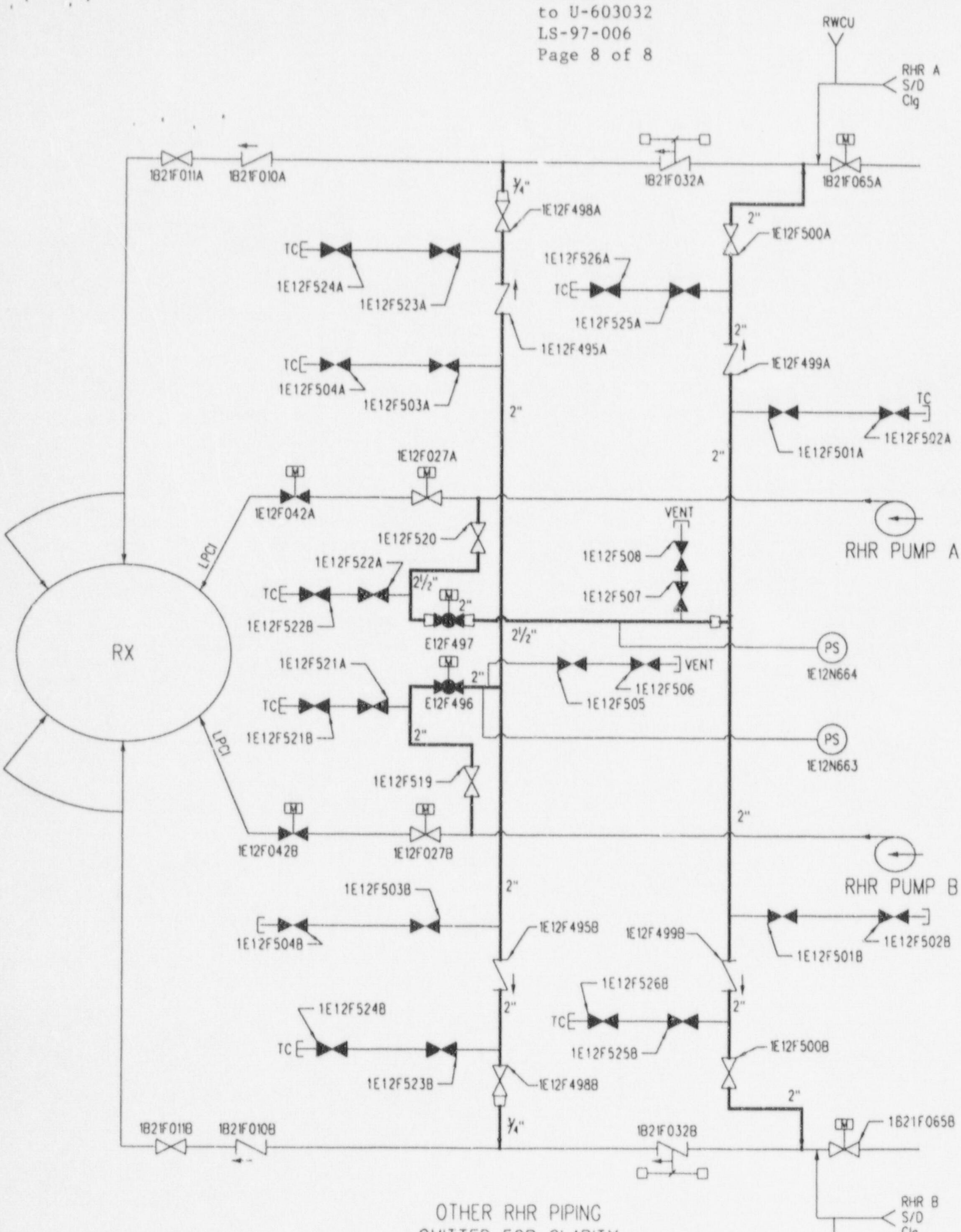
All valves requiring environmental qualification have either been previously environmentally qualified for the harsh environmental conditions or new environmental qualification packages will be prepared to address environmental concerns. Pressure switches 1E12-N663 and 1E12-N664, and new electrical components to be added to the MCC units will be located in a mild zone for which no environmental qualification is required. Electric cables used for this installation in harsh environmental zones are of the same type previously qualified for use at CPS and as such are environmentally qualified for this modification.

Primary Containment Penetration Qualification

The installation of the FWLC includes ¾ inch supply connections to the 20 inch main feedwater piping between the outboard containment isolation valves, 1B21-F032A/B and the containment penetration 1MC009 and 1MC010 head fittings. The affected main feedwater piping is ASME Class 1. A detailed ASME code stress and fatigue analysis to address the added fitting was performed and was based on the design Code of Record for CPS. Augmenting the ASME code requirements are the additional fatigue usage limits for this portion of piping, as defined in SRP Section 3.6.2, BTP MEB 3-1. The results provided in the analysis identified potential limitations on the fatigue life of the ¾ inch connection based on the fatigue usage limits of MEB 3-1. The new connections are qualified for at least as many remaining fatigue cycles as the existing FW lines therefore the connections are acceptable. The connections to the FW line upsteam of valves 1E12-F032A/B and to the RHR lines do not require fatigue analysis since the FW and RHR lines are ASME Class 2 lines.

Fire Protection

Increases in fire loading due to installation of insulating material for the new cables and lubricants in the new MOVs were analyzed and it was determined that the additional loads do not change the fire loading/severity classifications stated in the USAR for any of the affected fire zones. The new MOVs in the FWLCS do not perform any Appendix R safe shutdown functions. The RHR shutdown cooling mode is capable of its Appendix R safe shutdown function with these new MOVs in the closed position. Therefore, this modification has no impact on the Appendix R Safe Shutdown Analysis and Fire Protection Evaluation Report contained in USAR Appendix E and F.



OTHER RHR PIPING
OMITTED FOR CLARITY
TC - TEST CONNECTION

Impact of Feedwater Leakage Control System and Changes to Feedwater Containment Isolation Valve Leak Test Requirements on Analyzed Dose Consequences for Design Basis Accidents

As noted in Attachment 2, the proposed change (i.e., the introduction of the feedwater leakage control system (FWLCS) and corresponding changes to the leak test requirements for the feedwater containment isolation valves) affects or potentially affects the consequences of three important design basis accidents evaluated in the CPS USAR: (1) the design basis accident (DBA) - loss of coolant accident (LOCA), i.e., reactor recirculation line break; (2) the feedwater line break inside containment (FLBIC); and (3) the feedwater line break outside containment (FLBOC). An evaluation of the radiological impact of the FWLCS (and associated changes to the feedwater containment isolation valve leak test requirements) on these postulated events is thus provided in this attachment. Since, from a containment leakage and an offsite/onsite dose point of view, the DBA LOCA is the most limiting of these events, most of the discussion in this attachment is devoted to the dose analysis that was performed relative to the DBA LOCA.

I. Impact of Proposed Change on Dose Consequences for DBA LOCA

Radiological Analysis - Overall Approach and Basis

To evaluate the impact of the FWLCS and associated changes to the leak test requirements for the feedwater containment isolation valves on the radiological consequences of the DBA LOCA (reactor recirculation line break), new dose calculations were required to be performed relative to the dose calculations originally performed for the DBA LOCA analysis described in Section 15.6.5 of the CPS USAR. An appropriate time-and-dose model (described further below) was used to calculate the additional dose resulting from the "new" containment leakage path associated with the feedwater containment penetrations and the FWLCS. That is, the approach taken was to consider the feedwater penetration pathway separate and distinct from the other containment leakage pathways. The feedwater penetration pathway could then be analyzed separately (to determine, for example, appropriate, new leakage limits for the penetration), and then the dose contribution for the pathway could be added to the dose attributed to all of the other containment leakage pathways or sources.

While it was anticipated that offsite and main control room (MCR) doses would increase with the inclusion of the new FWLCS pathway (thus requiring changes to be made to USAR Section 15.6.5), it was also recognized that making changes to Section 15.6.5 of the CPS USAR provided an opportunity to incorporate additional changes based on two generically accepted methods or changes for removing some of the overly conservative assumptions or requirements used in the original DBA LOCA analyses for facilities. These two changes or methods, are (1) crediting suppression pool scrubbing for reduction of the radioiodine fission products assumed to be released from the containment following a DBA LOCA, and (2) utilization of the new dose conversion factors specified in ICRP 30. Approval of this amendment will incorporate these two methodologies into the licensing basis for CPS, and as such, future dose consequence analyses may utilize these methodologies in whole or in part to support plant activities or changes performed pursuant to the allowances of 10CFR50.59

Radioiodines and resultant thyroid doses are significantly reduced by suppression pool scrubbing. The acceptability and methodology for taking credit for the suppression pool as a fission product cleanup system is described in Section 6.5.5 of the Standard Review Plan (SRP) which was published in 1988. Since the dose assessment in the current USAR was completed prior to 1988, credit for suppression pool scrubbing was not allowed, even though the pool design met the criteria in SRP 6.6.5. Therefore, including this removal mechanism in the dose assessment model effectively credits a removal mechanism accepted by the NRC.

ICRP 30 dose conversion factors were used to calculate and, as a result, reduce the thyroid inhalation dose from airborne iodine. The new conversion factors are based on revised methods for calculating organ dose and relating organ dose to whole body dose, and are endorsed for use by the EPA in Federal Guidance Report #11. The statutory authority for the use of ICRP 30 and Federal Guidance #11 can be found in the Statements of Consideration for the publication of revised 10CFR20 as a Final Rule. The use of ICRP 30 and Federal Guidance Report #11 for calculating internal doses was discussed in Federal Register 56 FR 23360 (published May 5, 1991 and effective June 20, 1991). The NRC addressed a public comment regarding Section 20.1204, "Determination of Internal Exposure," by stating, "Appropriate parameters for calculating organ doses from radionuclide uptakes can be found in ICRP 30 and its supplements. Dose factors in Federal Guidance Report #11 are also acceptable for use in calculating occupational exposure...". The thyroid doses in the current USAR are based on dose conversion factors from Regulatory Guide 1.109. Using the ICRP 30 dose conversion factors removes conservatisms in the determination of dose consequences that are inherent in the use of other dose conversion factors. Thyroid dose conversion factors used in the FWLCS dose-impact analysis are included in Table 6 of this attachment (page 20).

As noted above, analysis of the leakage pathway introduced by the FWLCS required that it be analyzed separately but in addition to the pathways analyzed in the original or current analysis for the DBA LOCA. As discussed in USAR Section 15.6.5, and as depicted on Figure 1 (page 11 of this attachment)[1], the containment leakage (fission product transport) pathways originally considered for evaluation of the dose consequences of the DBA LOCA are as follows:

(1) L_1 = Leakage from the containment directly to the environs with no treatment by the SGTS. All of the containment leakage (0.65% per day) is assumed to occur via this pathway during drawdown by the standby gas treatment system (SGTS), which is assumed to occur for the first 188 seconds after the accident. From 188 seconds till 30 days post-LOCA, leakage via this pathway is limited to 0.08 L_a or 0.052% per day.

[1] Figure 1 corresponds to Figure 15.6.5-1 in the CPS USAR.

(2) L_2 = Leakage from the containment/drywell via the main steam isolation valves (MSIVs). This leakage, which is directed to and treated by the SGTS, is assumed to begin 2 hours post-LOCA, and is limited to 0.15% per day for all four valves (28 scfh/valve).

(3) L_3 = Leakage from the containment into the secondary containment which is drawn into and through the standby gas treatment system (SGTS). The assumed leakage rate = 0.92 L_a = 0.598%/day. No holdup time in the secondary containment is credited for this leakage.

Note:

Leakage paths L_4 and L_5 are associated with the realistic analysis for assessment of the dose consequences for the DBA LOCA. As such, they are not relevant to the design basis analysis addressed in USAR Section 15.6.5.5.1 nor to the analysis addressed in this attachment. These leakage paths appear in the USAR Figure 15.6.5-1, however, and are included in Figure 1 for consistency.

Introduction of the FWLCS and associated changes to the leak test requirements for the feedwater containment penetrations requires consideration of an additional leak path dedicated to the feedwater containment penetrations, which has two components, as depicted in Figure 2 (page 12 of this attachment). This pathway (depicted as L_6 in the figure) is also a secondary containment bypass leakage path, but is evaluated as a separate and distinct pathway to the environs that is in addition to the above-noted pathways. The leak rate assumed for this pathway corresponds to the leakage assumed to occur through the feedwater containment isolation valves has two components. For the purposes of analysis, leakage through this pathway is conservatively assumed to be entirely containment atmospheric leakage from the time immediately following the DBA LOCA until the feedwater piping is completely filled with water by the FWLCS. This time period is assumed to be one hour. Water leakage (post-LOCA suppression pool water) is also assumed to occur via this pathway, and is assumed to occur for the entire 30-day post-LOCA period. The limits assumed for these leakages, which were important inputs to the dose analysis performed, are further discussed below.

Calculation of the impact of the FWLCS on the dose consequences previously determined for the DBA LOCA (per USAR Section 15.6.5) was expected to yield changes to the associated dose consequences. As such, it was recognized that the calculated doses must meet the criteria of 10CFR50, Appendix A, GDC 19 (5 rem gamma whole body, 30 rem beta skin, and 30 rem thyroid in the main control room) and 10CFR100.11 [25 rem gamma whole body and 300 rem thyroid at the exclusion area boundary (EAB) and low population zone (LPZ)].

POSTDBA Time and Dose Model

The dose analysis performed to assess the impact of the FWLCS on the DBA LOCA analysis was based on the time-and-dose computer model, "POSTDBA." POSTDBA is a model developed by Sargent and Lundy and can be used to determine main control room, EAB, and LPZ doses for a prescribed set of input parameters.

POSTDBA is a different analytical tool than what was originally used by General Electric for the DBA LOCA dose analysis described in Section 15.6.5 of the CPS USAR. Therefore, a comparison or benchmark of the new model against the original was performed by reperforming the dose analysis for the DBA LOCA using assumptions and inputs consistent with those originally used. Consistent results were achieved such that use of the POSTDBA was deemed to be acceptable for assessing the radiological impacts of the FWLCS relative to design basis events.[2]

Design Inputs and Assumptions for POSTDBA Analysis

Specific plant data, as well as key inputs and/or assumptions utilized in the dose analysis are provided in Tables 1 through 6 of this attachment. (See pages 13 through 20 of this attachment.) Key assumptions or inputs are further discussed as follows.

Source Term: Table 15.6.5-2 of the CPS USAR provides values for the airborne iodine and noble gas activities in the containment at successive increments of time post LOCA (from one minute up to 30 days, post LOCA) based on the instantaneous release of 25% and 100% of the core inventories, respectively, as calculated in the original DBA LOCA analysis for CPS. (Values for the radioiodine and noble gas inventories at one minute post-LOCA are reproduced and provided for reference in Table 3 on page 17 of this attachment.) To apply suppression pool scrubbing, inventories at one minute post LOCA were used to back calculate inventories at t = 0 (based on radionuclide decay times). A suppression pool bypass fraction of 0.0158, based on the CPS suppression pool bypass design limit of 1.18 sq. ft., was utilized. Per Standard Review Plan (SRP) Section 6.5.5, 90% of the elemental and particulate iodines are removed by suppression pool scrubbing with the organic fraction remaining unaffected. The calculated fraction of radioiodines removed by the suppression pool was thus determined to be 85%. Using the Regulatory Guide (RG) 1.3 assumption that 25% of the shutdown inventory of radioiodines are

[2]The largest difference between the results of the POSTDBA comparison run and the original GE results was in the main control room whole body dose. This difference is attributed to the method used to correct for the finite cloud in the main control room. POSTDBA calculates a finite cloud correction factor for each radionuclide based on the energy distribution of the decay gammas and applies this to the doses calculated using Regulatory Guide (RG) 1.109 dose conversion factors. The original GE model apparently used a correction factor based on the main control room volume and a set of dose conversion factors using RG 1.109 methodology for a finite radius.

airborne and available for release to the environment, suppression pool scrubbing yields the result that 3.75% of the shutdown inventory of radioiodines are airborne and available for release to the environment. Results are shown on Table 4 on page 18 of this attachment.

With respect to radioiodines entrained in the suppression pool, 50% of the shutdown inventory of radioiodines is assumed to be diluted by the minimum suppression pool volume allowed by the Technical Specifications. This establishes a conservative radioiodine concentration in the suppression pool water with respect to dose evaluation of this source term (due to suppression pool water leakage assumed to occur through the feedwater line valves via the FWLCS for the 30-day post-LOCA period).

<u>χ/Q Values</u>: Since the dose model continues to assume that all containment leakage, including leakage through the feedwater isolation valves, is released to the environs via the station's main release point, the χ/Q values used for the analysis are as presented in USAR Section 15.6.5.5.3, "Control Room," for the main control room, and in USAR Table 15.6.5-1 for the EAB and LPZ. These values are collectively provided for reference in Table 5 on page 19 of this attachment.

<u>Containment Leakage and SGTS Filtering:</u> Leakage paths from the containment are as described previously. Values for the CPS containment and drywell free volumes (included in Table 1) were used to convert units for the containment leakage/flow rates from %/day to cfm. From these simple calculations, for the containment and MSIV leakages:

Containment Leak Rate = CLR = 8.1092 cfm, and
MSIV Leak Rate (based on 28 scfh/valve) = MSLR = 1.8667 cfm.

For the purposes of analysis, the total leak rate after two hours is the sum of the MSIV leakage and the containment leakage:

Total Leak Rate = 9.9759 cfm, after two hours post-LOCA.

As previously noted, during the post-LOCA secondary containment drawdown period (of 188 seconds) the entire containment leakage is assumed to be released directly (unfiltered) to the environs. After the drawdown period, 92% of the containment leakage is filtered via the SGTS (since such leakage flows into the secondary containment), while the remaining 8% continues to be released directly to the environs as secondary containment bypass leakage (thus bypassing the SGTS filter). The fractional efficiency of the SGTS is 0.99. In the POSTDBA model, however, the filtered leakage and bypass leakage are effectively combined by decreasing the effective fractional efficiency assigned to the SGTS filter:

$$\text{Effective Efficiency} = 1 - [(0.01)(0.92) + 0.08] = 0.9108$$

This POSTDBA input applies to filtering of the containment leakage from t = 188 seconds to t = 720 hours (30 days).

With respect to the MSIV leakage, which begins at t = 2 hours, none of it bypasses the SGTS filter. Therefore, the SGTS filter efficiency must be adjusted since the filter efficiency calculated above for containment leakage includes an 8% bypass leakage component. Thus,

$$CLR(1 - 0.9108) + MSLR(1-0.99) = (CLR + MSLR) \times (1 - E_x)$$

where E_x is the adjusted SGTS filter efficiency to be applied to the total containment and MSIV leakage from t = 2 hours to t = 720 hours. Substituting values for CLR and MSLR (given above) gives a resultant value of 0.9256 for E_x.

Control Room Make-up and Recirculation Filter: A filter efficiency for leakage that makes its way into the main control room (MCR) was calculated to account for both the make-up filter and the recirculation filter associated with the main control room ventilation system. From Table 1, the flow rate and design filter efficiency of the make-up filter are 3300 cfm and 0.99, respectively. The filter efficiency of the recirculation filter is 0.70. The inleakage filtered through the recirculation filter is 650 cfm, and the unfiltered inleakage is 10 cfm. To properly model the MCR filter paths and flows, including conserving the iodine inventory that enters the control room and accounting for the increased turnover due to the higher makeup rate, the makeup rate is increased to 3950 cfm, while the makeup filter efficiency is adjusted as follows:

$$(1 - E_c)(3950\ \text{cfm}) = (1 - 0.7)(650\ \text{cfm}) + (1 - 0.99)(3300\ \text{cfm}) \quad \text{so that } E_c = 0.9423.$$

(Note: Unfiltered inleakage was not included the original USAR GE model.)

Feedwater Line Leakage Leakage through the feedwater containment isolation valves is assumed to occur instantly following a DBA LOCA, so that during the time the feedwater lines are being filled by the FWLCS, post-LOCA containment atmosphere is assumed to leak through the feedwater containment isolation valves. Leakage of post-LOCA suppression pool water is assumed to occur through the feedwater penetration containment isolation valves, as supplied by the FWLCS, from the beginning of the accident and continuing for the remainder of the 30-day post-LOCA period. Both sources associated with this leakage pathway contribute to the doses evaluated for the post-LOCA period.

As noted previously, the intent of the FWLCS is to provide a water seal for the feedwater water isolation valves such that air-leak testing of the feedwater containment isolation valves will no longer be required. At the same time, as described above, it is conservative to assume full air leakage through the valves during the entire fill period. On the basis of the intent to only perform water-leak testing of the valves in the future, an empirical relationship between water leakage and air leakage through the check valves was determined. This is acceptable on the basis that a conservatively determined, bounding leakage value was established based on the significant number of valve test runs that were performed.

Specifically, the air leak rate as a function of water leak rate was determined empirically from valve testing at various, fixed disc positions. The resulting air leak rates were normalized from actual temperature and pressure measurements to conditions at 60°F and 9 psig, and then to containment LOCA conditions at 200°F and 9 psig. The data was enveloped using a straight line (y = mx + b), and the enveloping line was used to calculate air leak rate as a function of water leak rate. Air leak rates were determined for water leak rates of interest and adjusted from normalized test conditions (60°F, 9 psig) to containment LOCA conditions (200°F, 9 psig).

Based on the above, a total feedwater containment penetration water leakage of 3 gpm was selected for use in the dose analyses.

Iodine Partition Coefficient (IPC) and POSTDBA Purge Filter Efficiency for Suppression Pool Water Leakage Source: The IPC is used to calculate the fraction of iodine in the suppression pool that becomes airborne and released to the environment. (This is modeled in POSTDBA by converting the IPC to a filter efficiency and using this as input for the "purge" filter efficiency in POSTDBA.)

At equilibrium, IPC = (concentration in liquid)/(concentration in gas).

PER ORNL-TM-2412, the IPC may be calculated as a function of molar concentration, pH, and temperature. The IPC was calculated using the following data:

Mass of Iodine in core at shutdown = 182.3 gram-atoms
Amount of Iodine from core that dissolves in the suppression pool = 50%
Suppression Pool Volume = 146,400 cu. ft. = 4.14559E+6 liters
pH of Suppression Pool = 7 (neutral)
Suppression Pool Temperature = 80°C (176°F)

Using ORNL-TM-2412 and linear interpolation, for a calculated molar concentration of 2.1987E-5 moles/liter, IPC = 73.4. Thus, the ratio of iodine in the air to that in the water is 1/73.4, which means that 1.3624% of the iodine is released to the air (i.e., the environs). (This corresponds to a POSTDBA "purge" filter efficiency of 1 - 0.013624 ≈ 98.64.)

Resultant/Calculated Doses from POSTDBA Analysis

Resultant doses calculated via POSTDBA reflect the contribution to main control room, EAB, and LPZ doses due to leakage from the feedwater penetration pathway, i.e., the additional leakage of post-LOCA containment atmosphere through the feedwater lines prior to completion of the assumed FWLCS fill time, and the leakage of post-LOCA suppression pool water through the feedwater containment isolation valves. Table 7 provides the resultant doses, and for comparison purposes, also provides the dose values for the current licensing basis as well as the doses resulting from application of pool scrubbing and the ICRP 30 dose conversion factors to the current licensing basis without the FWLCS.

II. **Feedwater Line Break Inside Containment (FLBIC)**

Although (as noted in Attachment 2) no quantitative design basis analysis for the FLBIC is provided in the USAR (only a quantitative realistic analysis is provided), a dose analysis for the FLBIC was performed anyway to assess the impact of the FWLCS and associated changes on the radiological consequences of this event. The main control room, EAB, and LPZ radiological doses were calculated using POSTDBA. The postulated feedwater line break takes place in the drywell with 40 percent of the primary coolant flashing to steam allowing all of the iodine in the flashed steam to become airborne. For this calculation, no credit was taken for suppression pool scrubbing. With the pressurization of the drywell, the drywell atmosphere is postulated to leak to the environment through the feedwater isolation valves in the broken feedwater line. To be conservative, it was assumed that the leakage starts immediately with instantaneous flashing, and the drywell atmosphere continues to leak for 20 minutes. For comparison purposes the doses associated with a 30-day leakage of containment atmosphere were also calculated. This analysis used the Technical Specification maximum limit of 4.0 μCi/g I-131 Dose Equivalent with the corresponding ICRP 30 dose conversion factor.

The controlling dose for the FLBIC is the 2-hour EAB dose. The LPZ and the MCR dose are substantially below the limits for this accident scenario, 30 rem thyroid (10% 10CFR100) at the LPZ and EAB and 30 rem thyroid for the control room (GDC 19), respectively. For the EAB dose to approach the thyroid limit of 10 percent of 10CFR100 (30 rem) the drywell atmosphere would have to leak at a rate of approximately one air change every ten (10) minutes.

III. **Feedwater Line Break Outside Containment (FLBOC)**

The FLBOC is the least limiting of the three accident scenarios evaluated for the FWLCS and associated changes. As reactor coolant system isolation valves, the feedwater check valves can continue to be credited to limit reactor vessel inventory loss for this event, since this function remains unaffected by the proposed changes. The source term and postulated sequence of events for this accident remain unchanged. That is, the only release of activity from this accident would come from the activity present in the reactor coolant during normal plant operation. However, since the amount of coolant released is limited by the feedwater check valves, this event remains bounded by other events involving a line break outside containment, such as the main steam line break. On this basis, no new or additional analysis was required or performed.

LEAKAGE FLOW FOR LOCA

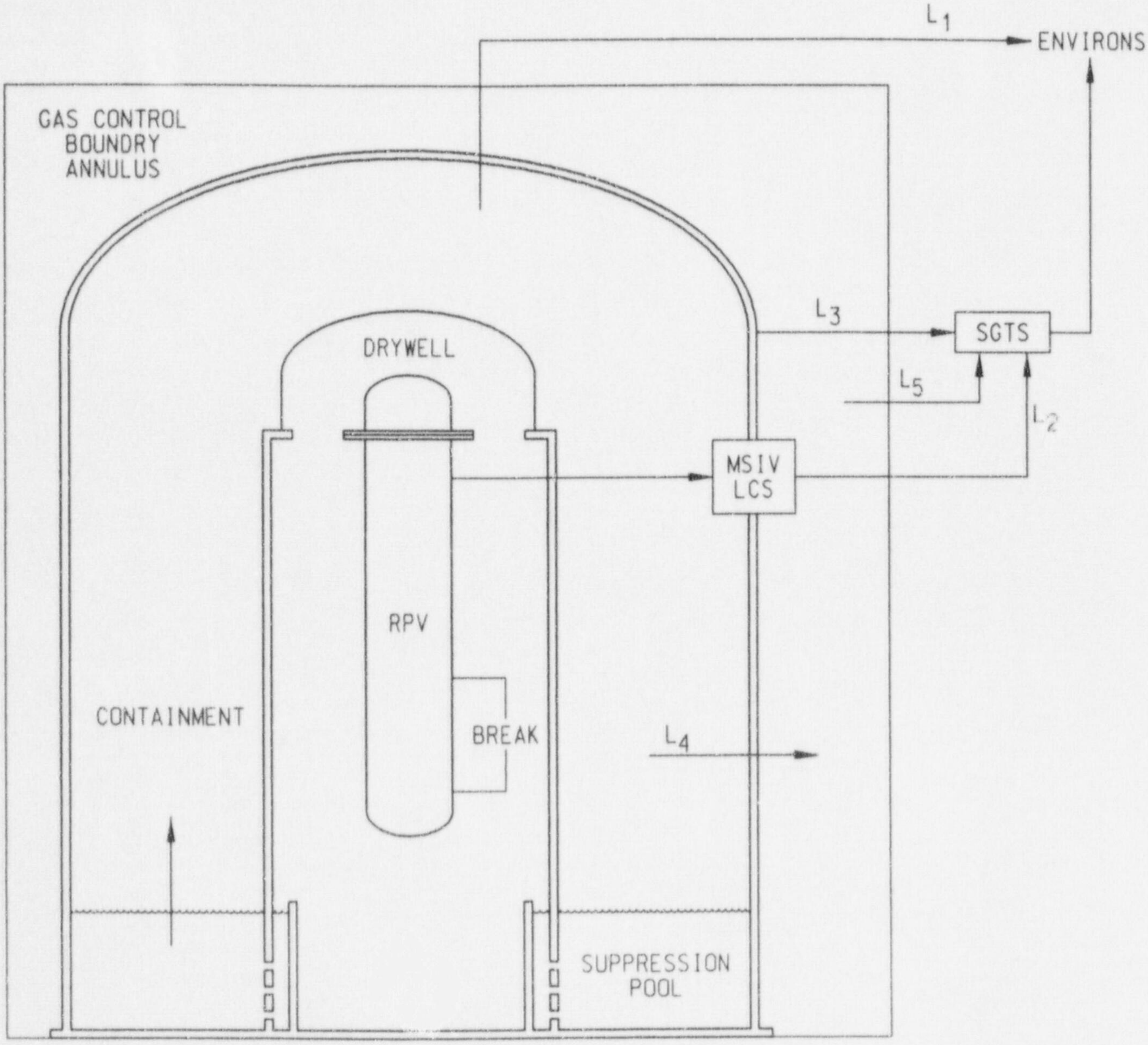


Figure 1

LEAKAGE FLOW FOR LOCA (WITH FWLCS)

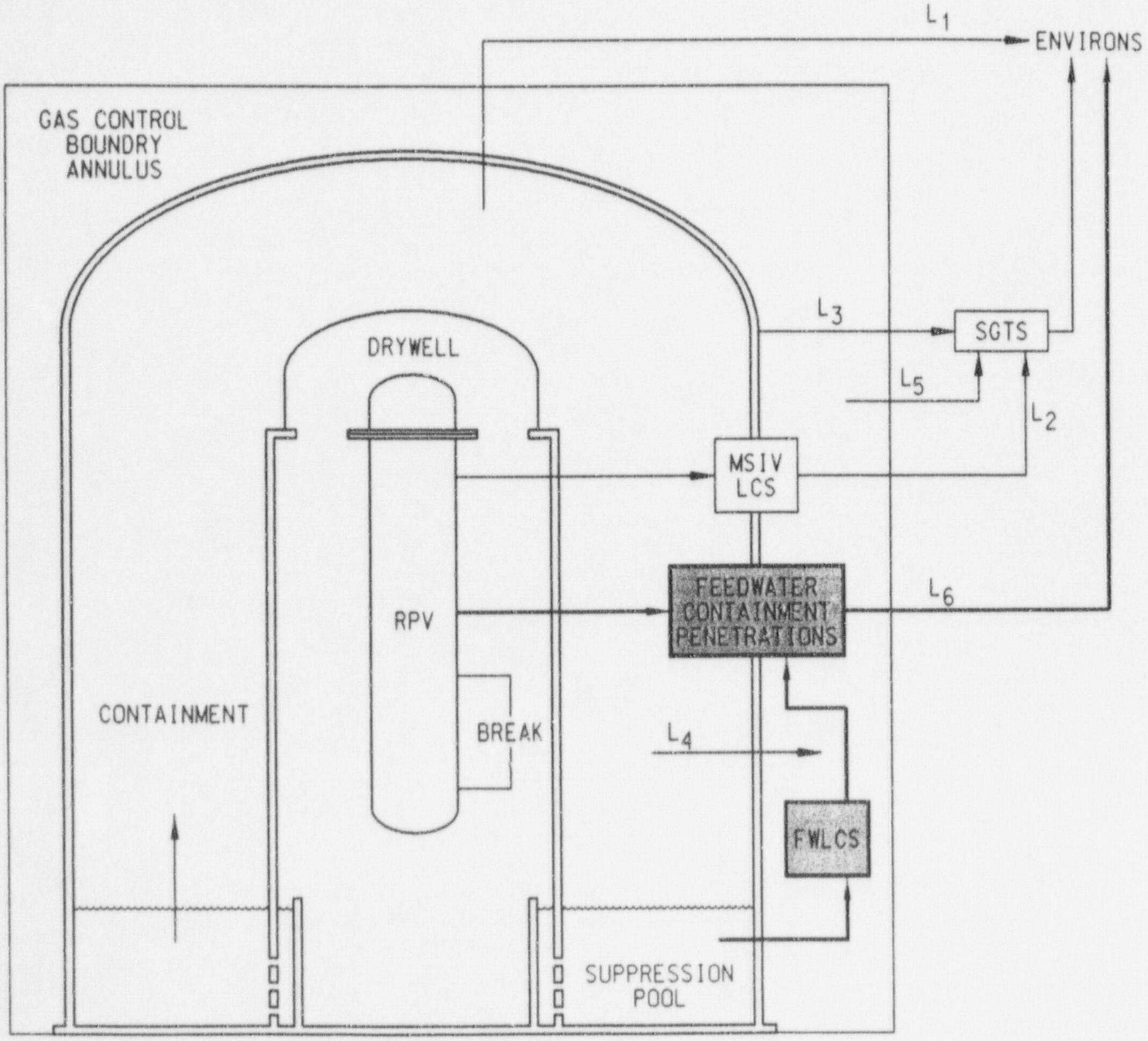


Figure 2

Table 1

Plant Data Used in the Dose Calculations

Item	Value
Primary Containment Data	
Leak Rate (%/day)	0.65
Containment Free Volume (ft^3)	1.55E+06
Drywell Free Volume (ft^3)	246,500
Projected Area Normal to Wind (m^2)	1460.
MSIV Leak Rate (SCFH per line)	28
Suppression Pool Vent Area (ft^2)	420
Elemental Iodine Fraction	0 .91
Particulate Iodine Fraction	0 .05
Organic Iodine Fraction	0 .04
SGTS Fractional Efficiency for Iodines (after drawdown)	0.99
Suppression Pool Water Volume (ft^3)	146,400
Secondary Containment Bypass Fraction	8%
Drawdown Time (sec)	188
Control Room Data	
Free Volume (ft^3)	3.2400E+05
Make-up Air Flow Rate (cfm)	3300
Recirculation Air Flow Rate (cfm)	54900

Table 1 (cont.)

Plant Data Used in the Dose Calculations

Item	Value
Make-up Air Filter Fractional Efficiency for Iodines	0.99
Recirculation Air Filter Fractional Efficiency for Iodines	0.70
Unfiltered Inleakage Rates (cfm)	10
Filtered Inleakage Rates (cfm)	650
Breathing Rates (m^3/sec)	
Control Room	3.47E-4
EAB and LPZ	
0-8 Hours	3.47E-04
8-24 Hours	1.75E-04
1-30 Days	2.32E-04

Table 2

DOSE CALCULATION ASSUMPTIONS

The following assumptions are noted.

1. 100% of the noble gases and 25% of the iodines of the shutdown core inventory are airborne instantaneously and available for release to the environment. Note, when credit is taken for suppression pool scrubbing, the iodine is reduced to 15% of this 25%.

2. No mixing in the secondary containment.

3. The filtered and unfiltered leakage enter the control room at the make-up inlet, i.e. the same χ/Q' as the make-up flow rate is applicable.

4. Containment and MSIV source terms are uniformly mixed in the drywell and primary containment free volumes.

5. During the drawdown time all the leakage is released unfiltered, i.e., 100% SGTS bypass.

6. MSIV leakage starts two (2) hours after shutdown and 100% of the MSIV leakage is filtered by the SGTS.

7. After drawdown time is reached, 92% of the containment leakage is filtered by the SGTS and 8% of the containment leakage bypasses the secondary containment and the SGTS.

8. Because the height of the SGTS stack with the respect to the containment building, releases from this pathway are at ground level.

9. There is a constant 10 cfm unfiltered inleakage into the control room.

10. Containment atmosphere leaks at a constant rate through the feedwater isolation valves equal to the tested leak rate of the feedwater check valves until the feedwater line is filled

11. The suppression pool source is 50% of the core inventory of iodines uniformly distributed in a volume of water equal to the minimum suppression pool volume.

Table 2 (cont.)

12. Suppression pool water is conservatively assumed to leak through the feedwater check valves from the beginning of the accident for 30 days.

13. The leakage through the feedwater valves is released unfiltered from the plant stack, which is co-located with the SGTS stack. Therefore, the (χ/Q')'s for the SGTS are used for these releases.

14. A partition factor of 73.4 is used for the iodine in the suppression pool water, i.e., 1.36% of the activity in the suppression pool water that leaks through the feedwater isolation valves becomes airborne and is available for release from the plant.

15. The containment pressure and temperature are assumed to be 9 psig and 200 deg. F, respectively, for the entire period of the accident.

16. The control room filtered inleakage is 650 cfm. This is consistent with Section 15.6.5.5.3 of the FSAR.

17 The duration of the accident is 30 days.

18 The suppression pool water temperature is assumed to be 80 °C (176 °F). This is consistent with Figure .2-8 of the FSAR.

Table 3

Unscrubbed Containment Airborne Shutdown Source Terms (Ci)

Isotopes*	T=1 Minute Source Term	Decay Constant, hr^{-1}	T=0 Shutdown Source Term
I-131	2.00E+07	3.592E-03	2.000E+07
I-132	2.91E+07	3.014E-01	2.925E+07
I-133	4.18E+07	3.332E-02	4.182E+07
I-134	4.54E+07	7.907E-01	4.600E+07
I-135	3.94E+07	1.049E-01	3.947E+07
Kr-83m	9.47E+06	3.788E-01	9.530E+06
Kr-85m	2.04E+07	1.547E-01	2.045E+07
Kr-85	9.16E+05	7.381E-06	9.160E+05
Kr-87	3.89E+07	5.451E-01	3.926E+07
Kr-88	5.54E+07	2.441E-01	5.563E+07
Kr-89	5.56E+07	1.316E+01	6.924E+07
Xe-131m	4.81E+05	2.439E-03	4.810E+05
Xe-133m	7.00E+06	1.319E-02	7.002E+06
Xe-133	1.68E+08	5.506E-03	1.680E+08
Xe-135m	3.03E+07	2.708E+00	3.170E+07
Xe-135	2.17E+07	7.609E-02	2.173E+07
Xe-137	1.23E+08	1.086E+01	1.474E+08
Xe-138	1.33E+08	2.943E+00	1.397E+08

* 25% full core inventory of iodine; 100% full core inventory of noble gas

Table 4
Scrubbed Containment Airborne Shutdown Source Terms (Ci)

Isotopes	T=0 Shutdown Source Term
I-131	3.00E+06
I-132	4.39E+06
I-133	6.27E+06
I-134	6.90E+06
I-135	5.92E+06

Table 5

Atmospheric Dispersion Data, χ/Q', sec/m^3

Time Period	Current USAR Values
Control Room*	
0-2 Hours	4.61E-04
2-8 Hours	4.61E-04
8-24 Hours	2.73E-04
1-4 Days	9.03E-05
4-30 Days	1.61E-05
Exclusion Area Boundary (EAB)	
0-2 Hours	1.80E-04
Low Population Zone (LPZ)	
0-2 Hours	4.20E-05
2-8 Hours	1.30E-05
8-24 Hours	8.20E-06
1-4 Days	3.30E-06
4-30 Days	1.60E-06

*χ/Q values for the control room include occupancy factors and credit for a factor of 4 reduction for the effects of dual separated air intakes.

Table 6

Dose Conversion Factors

Thyroid Dose Conversion Factors (rem/Ci)		
Nuclide	**Regulatory Guide 1.109(Adult)**	**Updated Values**
I-131	1.49E+06	1.08E+06
I-132	1.43E+04	6.40E+03
I-133	2.69E+05	1.80E+05
I-134	3.73E+03	1.07E+03
I-135	5.60E+04	3.13E+04

Table 7
Summary of Radiological Effects (Rem)

30-Day MCR	Current CPS Licensing Basis Dose (as reflected in the USAR)	Effect of using POSTDBA, ICRP 30, *** and suppression pool scrubbing	FWLCS dose calculation results ***	Proposed new CPS Licensing Basis Dose *** (DBA-LOCA)	10CFR50 Appendix A GDC 19 Limit (SRP 6.4 II.6)
Thyroid	**4.3 (27)***	**2.874**	**8.624**	**8.6**	**30**
γ-Whole Body	**2.0**	**2.524**	**3.51****	**3.5**	**5**
β-Skin	**14.3**	**13.69**	**17.10**	**17.1**	**30**

2-Hour EAB	Current CPS Licensing Basis Dose (as reflected in the USAR)	Effect of using POSTDBA, ICRP 30, *** and suppression pool scrubbing	FWLCS dose calculation results ***	Proposed new CPS Licensing Basis Dose *** (DBA-LOCA)	10CFR100.11 Limit
Thyroid	**163**	**17.31**	**198.1**	**198**	**300**
γ-Whole Body	**4.4**	**3.728**	**9.786**	**9.8**	**25**

30-Day LPZ	Current CPS Licensing Basis Dose (as reflected in the USAR)	Effect of using POSTDBA, ICRP 30, *** and suppression pool scrubbing	FWLCS dose calculation results ***	Proposed new CPS Licensing Basis Dose *** (DBA-LOCA)	10CFR100.11 Limit
Thyroid	**156**	**17.57**	**76.04**	**76**	**300**
γ-Whole Body	**1.7**	**1.549**	**2.981**	**3.0**	**25**

* The 27 rem value was previously allowed when accounting for 650 cfm of filtered duct leakage. The dose model used for calculating the FWLCS dose included and accounted for filtered duct leakage.

** This value includes aproximately 0.459 rem from external shine sources.

*** ICRP 30 dose conversion factors were used for thyroid doses. Reg. Guide 1.109 dose conversion factors were used for γ-whole body and β-skin doses.